

Supplemental Material

Symptoms and Medication Use in Children and Traffic-related Sources of Fine Particle Pollution

Janneane F. Gent, Petros Koutrakis, Kathleen Belanger, Elizabeth Triche, Theodore R. Holford, Michael B. Bracken, Brian P. Leaderer

Filter analysis. Minimum detection limit (MDL) for elements is defined as 3 times the analysis uncertainty (a value reported by DRI separately for each element for each sample (Bevington 1969)). Results for the 17 elements as well as elemental carbon (EC) used in the source apportionment analysis are shown in Supplemental Material, Table 1. Of 51 elements examined by XRF, 23 (Sc, Co, Ga, Yt, Nb, Pd, Ag, In, Sb, Cs, La, Ce, Sm, Eu, Tb, Hf, Ta, Wo, Ir, Au, Hg, Tl, Ur) never exceeded the MDL, another 10 (Mg, Cr, As, Se, Rb, Sr, Zr, Mo, Cd, Sn) did not exceed the MDL 90 - 99% of the time, and at least three-fourths of the values for another 4 elements did not exceed their MDLs (Na (82%), Mn (76%), Br (78%), Pb (77%)). Data were entered into the factor analysis as the concentration reported by DRI, including concentrations below the MDL. Concentrations below the MDL have a small effect on correlations among elements and do not significantly affect the outcome of the factor analysis. These low concentrations also contribute important information regarding the strength of one or more particle sources. Of course, if all daily concentrations of an element are below the MDL then it is not meaningful to include that element in the source apportionment analysis. However, although infrequently detected, Na, Se and Pb were included in source apportionment analysis since they are important tracer elements for “sea salt” (Na), “coal” (Se) and “motor vehicle” (Pb) (U.S. Environmental Protection Agency 2008).

Light reflectance analysis. Prior to XRF, EC concentrations were estimated using an optical reflectance technique (Cyrus et al. 2003; Janssen et al. 2001; Kinney et al. 2000). An absorption coefficient, “a,” was calculated for each filter using the following formula (International Organization for Standardization, Geneva, Switzerland; ISO9835):

$$a = 10^5 \times 0.5A \times \ln(RO/RF)/V$$

where A = the deposit area of the filter (in m²); RO is the reflectance of a clean reference filter (set to 100%); RF is the percent reflectance of the sample filter; V is the volume of air sampled in m³. By convention, the absorption coefficient is expressed in units multiplied by a factor of 10⁵. Given the deposit area of 0.001195 m², the absorption formula for filters in this study becomes:

$$a = 59.7 \times \ln(RO/RF)/V.$$

In previous studies, conversion of EC absorption coefficients to EC concentrations has been accomplished by using co-located measurements of EC using a reference method (e.g., by thermal optical reflectance (TOR) from quartz filters) (Cyrus et al. 2003; Janssen et al. 2001; Kinney et al. 2000). Although we did not have co-located quartz PM_{2.5} filters, we were able to acquire 30, co-located high-volume quartz PM₁₀ filters with particle concentrations ranging from 10 to 60 µg/m³. EC from TOR analysis of the PM₁₀ filters (mean (SD) 3.2 (1.7) µg/m³; range 0.5 to 7.5 µg/m³) was compared to EC estimated from reflectance measurements of teflon PM_{2.5} filters from the same site and days (mean (SD) 2.2 (1.1) µg/m³; range 0.2 to 4.7 µg/m³). The correlation of EC estimated from the two methods was high, r=0.9. Our TOR and reflectance results are similar to others where the relationship between the concentration of EC (µg/m³) and “a” appears to be between 0.81 for 5 summer days in New York City (Kinney et al. 2000) to 0.9, 1.6, and 2.0 based on annual averages from urban sites in Sweden, The Netherlands and Germany, respectively (Cyrus et al. 2003). For our calculations, we assumed a factor of 1.0, thus

$$\mu\text{g EC}/V = a$$

which reduces to

$$\mu\text{g EC} = 59.7 \times \ln(RO/RF).$$

Data were entered into the factor analysis as a concentration which was calculated by dividing each filter's EC mass by the collection volume for that filter. MDL for EC is defined as 3 times the standard deviation of the value determined by reflectance analysis of field blanks (n=46 filters taken to the field and returned to the lab unexposed) (Supplemental Material, Table 1). Concentrations below the value calculated for lab blanks (n=11 filters never exposed) (mean (SD) 0.025 (0.008) $\mu\text{g}/\text{m}^3$) were assigned a value of 0.001 $\mu\text{g}/\text{m}^3$.

References

- Bevington PR. 1969. Data Reduction and Error Analysis for the Physical Sciences. New York, NY: McGraw Hill.
- Cyrys J, Heinrich J, Hoek G, Meliefste K, Lewne M, Gehring U, et al. 2003. Comparison between different traffic-related particle indicators: Elemental carbon (EC), PM_{2.5} mass, and absorbance. *J Exp Anal Environ Epidemiol* 13:134-143.
- Janssen NAH, van Vliet PHN, Aarts F, Harssema H, Brunekreef B. 2001. Assessment of exposure to traffic related air pollution of children attending schools near motorways. *Atmos Environ* 35:3875-3884.
- Kinney PL, Aggarwal M, Northridge ME, Hanssen NAH, Shepard P. 2000. Airborne concentrations of PM_{2.5} and diesel exhaust particles on Harlem sidewalks: a community-based pilot study. *Environ Health Perspect* 108(3):213-218.
- U.S. Environmental Protection Agency. 2008. National Emissions Inventory (NEI). Available: <http://www.epa.gov/ttn/chief/eiinformation/speciate> [accessed 1 April 2008].

Table 1. Elements (in order of atomic weight) used in factor analysis (in ng/m³) for New Haven, CT (Aug 2000 - Jan 2004).

| Analysis method/ | | % Below MDL ^a | | | | | |
|---------------------------|------------------|-----------------------------|--------|--------|--------|--------|------|
| Species | Mean | SD | Min | Median | Max | | |
| X-ray fluorescence | | | | | | | |
| Na | Sodium | 180.8 | 167.4 | 0.0 | 146.0 | 1556.4 | 82.5 |
| Al | Aluminum | 67.5 | 55.4 | 2.1 | 55.2 | 783.0 | 22.3 |
| Si | Silicon | 117.0 | 110.8 | 0.0 | 90.6 | 1567.3 | 10.1 |
| P | Phosphorous | 64.8 | 44.9 | 0.3 | 54.5 | 307.6 | 2.0 |
| S | Sulfur | 1451.8 | 1092.0 | 0.0 | 1182.2 | 7824.3 | 1.9 |
| Cl | Chlorine | 29.6 | 115.6 | 0.0 | 6.0 | 1590.8 | 39.1 |
| K | Potassium | 63.2 | 131.0 | 0.0 | 44.4 | 2790.1 | 39.2 |
| Ca | Calcium | 51.2 | 32.6 | 0.0 | 44.6 | 331.0 | 2.6 |
| Ti | Titanium | 7.4 | 8.0 | 0.0 | 6.5 | 221.4 | 10.6 |
| V | Vanadium | 9.9 | 11.5 | 0.0 | 6.4 | 112.9 | 7.9 |
| Fe | Iron | 219.0 | 125.2 | 0.0 | 202.0 | 1094.4 | 4.7 |
| Ni | Nickel | 5.2 | 5.3 | 0.0 | 3.9 | 50.5 | 16.8 |
| Cu | Copper | 6.3 | 4.3 | 0.0 | 5.8 | 79.5 | 15.0 |
| Zn | Zinc | 23.0 | 21.0 | 0.0 | 17.1 | 282.5 | 2.3 |
| Se | Selenium | 0.5 | 0.9 | 0.0 | 0.0 | 7.1 | 94.8 |
| Ba | Barium | 12.6 | 10.9 | 0.0 | 11.3 | 159.3 | 21.9 |
| Pb | Lead | 4.9 | 5.6 | 0.0 | 3.9 | 132.0 | 77.0 |
| Reflectance | | | | | | | |
| EC | Elemental carbon | 1894.5 | 1085.2 | 1.0 | 1881.3 | 8153.6 | 8.8 |

^a Minimum detection limit (MDL) for elements is defined as 2 times the analysis uncertainty (a value reported separately for each element for each sample) (Desert Research Institute, Reno, NV, (Bevington 1969)). MDL for EC is defined as 3 times the standard deviation of the value determined by reflectance analysis of field blanks (n=46 filters taken to the field and returned to the lab unexposed).

Table 2. Odds ratios and p-values from separate repeated measures logistic regression analyses of associations between daily respiratory symptoms and medication use and each daily elemental concentration of PM_{2.5}. Each element is shown for exposures lagged by 0, 1 or 2 days (L0, L1, L2), and the mean of days 0 - 2 (L02). (N=149 asthmatic children)^a

| Source/ Element | Lag | ng/m ³ unit incr | Wheeze | | Persistent cough | | Shortness of breath | | Chest tightness | | Inhaler short-acting | |
|------------------------|-----|--------------------------------|--------|------|---------------------|------|------------------------|-------|--------------------|------|-------------------------|------|
| | | | OR | p | OR | p | OR | p | OR | p | OR | p |
| "Motor vehicle" | | | | | | | | | | | | |
| EC | L0 | 1000 | 1.04 | 0.04 | 1.01 | 0.42 | 1.06 | 0.001 | 1.03 | 0.20 | 1.01 | 0.15 |
| | L1 | 1000 | 1.01 | 0.70 | 1.01 | 0.38 | 1.01 | 0.65 | 1.02 | 0.24 | 1.00 | 0.72 |
| | L2 | 1000 | 1.00 | 0.99 | 0.99 | 0.44 | 1.01 | 0.63 | 1.01 | 0.59 | 1.00 | 0.75 |
| | L02 | 1000 | 1.07 | 0.06 | 1.03 | 0.23 | 1.12 | 0.01 | 1.10 | 0.04 | 1.02 | 0.40 |
| Zn | L0 | 10 | 1.00 | 0.69 | 1.00 | 0.60 | 1.02 | 0.001 | 1.00 | 0.72 | 1.00 | 0.41 |
| | L1 | 10 | 0.99 | 0.54 | 1.00 | 0.77 | 1.00 | 0.57 | 1.00 | 0.96 | 1.00 | 0.44 |
| | L2 | 10 | 1.00 | 0.89 | 0.99 | 0.24 | 1.01 | 0.49 | 1.01 | 0.38 | 1.00 | 0.52 |
| | L02 | 10 | 1.00 | 0.98 | 1.00 | 0.94 | 1.04 | 0.06 | 1.03 | 0.13 | 1.01 | 0.53 |
| Pb | L0 | 5 | 1.02 | 0.31 | 1.02 | 0.25 | 1.03 | 0.11 | 1.02 | 0.31 | 1.01 | 0.06 |
| | L1 | 5 | 1.00 | 0.91 | 1.00 | 0.88 | 0.98 | 0.51 | 0.99 | 0.79 | 0.98 | 0.11 |
| | L2 | 5 | 1.01 | 0.62 | 1.00 | 0.87 | 1.03 | 0.05 | 1.03 | 0.13 | 1.02 | 0.04 |
| | L02 | 5 | 1.07 | 0.13 | 1.05 | 0.12 | 1.12 | 0.01 | 1.10 | 0.02 | 1.04 | 0.10 |
| Cu | L0 | 5 | 1.01 | 0.59 | 1.02 | 0.13 | 1.06 | 0.01 | 1.03 | 0.23 | 1.01 | 0.22 |
| | L1 | 5 | 0.99 | 0.55 | 1.02 | 0.21 | 1.01 | 0.74 | 1.02 | 0.42 | 0.99 | 0.37 |
| | L2 | 5 | 0.99 | 0.82 | 0.98 | 0.26 | 0.96 | 0.10 | 0.97 | 0.17 | 1.00 | 0.70 |
| | L02 | 5 | 1.02 | 0.67 | 1.05 | 0.04 | 1.06 | 0.21 | 1.04 | 0.39 | 1.01 | 0.46 |
| Se | L0 | 1 | 1.00 | 0.97 | 1.00 | 0.84 | 1.02 | 0.40 | 1.00 | 0.79 | 0.99 | 0.20 |
| | L1 | 1 | 0.99 | 0.52 | 0.99 | 0.32 | 0.97 | 0.10 | 0.97 | 0.13 | 1.01 | 0.02 |
| | L2 | 1 | 1.00 | 0.91 | 1.00 | 0.93 | 1.01 | 0.55 | 1.01 | 0.72 | 0.99 | 0.32 |
| | L02 | 1 | 1.02 | 0.71 | 0.98 | 0.43 | 1.02 | 0.67 | 0.98 | 0.61 | 0.99 | 0.75 |

Table 2, cont.

| Source/ Element | Lag | ng/m ³ unit incr | Wheeze | | Persistent cough | | Shortness of breath | | Chest tightness | | Inhaler short-acting | |
|--------------------|-----|--------------------------------|--------|------|---------------------|-------|------------------------|-------|--------------------|------|-------------------------|-------|
| | | | OR | p | OR | p | OR | p | OR | p | OR | p |
| "Road dust" | | | | | | | | | | | | |
| Si | L0 | 100 | 1.03 | 0.03 | 1.02 | 0.01 | 1.04 | 0.01 | 1.02 | 0.20 | 1.02 | 0.004 |
| | L1 | 100 | 1.00 | 0.99 | 1.00 | 0.78 | 1.01 | 0.60 | 1.02 | 0.17 | 0.99 | 0.18 |
| | L2 | 100 | 1.02 | 0.26 | 1.01 | 0.60 | 1.01 | 0.63 | 1.00 | 0.88 | 1.01 | 0.45 |
| | L02 | 100 | 1.07 | 0.04 | 1.05 | 0.02 | 1.08 | 0.02 | 1.06 | 0.10 | 1.03 | 0.09 |
| Fe | L0 | 100 | 1.04 | 0.02 | 1.02 | 0.06 | 1.06 | 0.002 | 1.01 | 0.47 | 1.02 | 0.004 |
| | L1 | 100 | 1.00 | 0.80 | 1.01 | 0.52 | 1.01 | 0.65 | 1.02 | 0.22 | 0.99 | 0.44 |
| | L2 | 100 | 1.00 | 0.87 | 0.99 | 0.52 | 0.98 | 0.27 | 0.98 | 0.35 | 1.00 | 0.91 |
| | L02 | 100 | 1.07 | 0.05 | 1.04 | 0.04 | 1.08 | 0.04 | 1.05 | 0.21 | 1.03 | 0.08 |
| Al | L0 | 50 | 1.02 | 0.17 | 1.03 | 0.002 | 1.05 | 0.002 | 1.02 | 0.21 | 1.02 | 0.02 |
| | L1 | 50 | 1.01 | 0.73 | 1.00 | 0.96 | 1.01 | 0.63 | 1.02 | 0.18 | 0.99 | 0.27 |
| | L2 | 50 | 1.02 | 0.30 | 1.00 | 0.68 | 1.01 | 0.59 | 1.00 | 0.94 | 1.01 | 0.50 |
| | L02 | 50 | 1.07 | 0.03 | 1.06 | 0.01 | 1.09 | 0.004 | 1.07 | 0.04 | 1.02 | 0.11 |
| Ca | L0 | 50 | 1.07 | 0.02 | 1.05 | 0.01 | 1.10 | 0.002 | 1.04 | 0.26 | 1.04 | 0.01 |
| | L1 | 50 | 1.00 | 0.97 | 0.99 | 0.64 | 1.02 | 0.66 | 1.03 | 0.43 | 0.97 | 0.06 |
| | L2 | 50 | 1.01 | 0.74 | 1.00 | 0.90 | 1.00 | 0.89 | 1.00 | 0.93 | 1.01 | 0.44 |
| | L02 | 50 | 1.14 | 0.04 | 1.09 | 0.03 | 1.18 | 0.01 | 1.14 | 0.07 | 1.04 | 0.17 |
| Ba | L0 | 10 | 0.99 | 0.57 | 1.00 | 0.83 | 1.04 | 0.02 | 1.01 | 0.63 | 1.01 | 0.08 |
| | L1 | 10 | 1.00 | 0.92 | 1.01 | 0.38 | 1.00 | 0.96 | 1.00 | 0.88 | 0.99 | 0.19 |
| | L2 | 10 | 0.99 | 0.48 | 0.99 | 0.32 | 0.96 | 0.05 | 0.98 | 0.30 | 1.00 | 0.92 |
| | L02 | 10 | 0.99 | 0.81 | 1.00 | 0.81 | 1.03 | 0.38 | 1.02 | 0.51 | 1.01 | 0.36 |
| Ti | L0 | 5 | 1.00 | 0.59 | 1.00 | 0.57 | 1.01 | 0.01 | 1.00 | 0.34 | 1.00 | 0.72 |
| | L1 | 5 | 0.99 | 0.49 | 1.00 | 0.55 | 1.00 | 0.56 | 1.00 | 0.55 | 1.00 | 0.30 |
| | L2 | 5 | 1.01 | 0.34 | 1.00 | 0.30 | 1.00 | 0.60 | 0.99 | 0.49 | 1.00 | 0.67 |
| | L02 | 5 | 1.01 | 0.56 | 1.01 | 0.29 | 1.03 | 0.05 | 1.01 | 0.52 | 1.00 | 0.66 |

Table 2, cont.

| Source/ Element | Lag | ng/m ³ unit incr | Wheeze | | Persistent cough | | Shortness of breath | | Chest tightness | | Inhaler short-acting | |
|--------------------------|-----|--------------------------------|--------|------|---------------------|------|------------------------|------|--------------------|------|-------------------------|------|
| | | | OR | p | OR | p | OR | p | OR | p | OR | p |
| "Sulfur" | | | | | | | | | | | | |
| S | L0 | 1000 | 0.98 | 0.43 | 1.00 | 0.84 | 1.01 | 0.63 | 0.99 | 0.80 | 0.99 | 0.13 |
| | L1 | 1000 | 0.99 | 0.62 | 1.00 | 0.69 | 0.99 | 0.71 | 1.01 | 0.62 | 1.00 | 0.81 |
| | L2 | 1000 | 1.02 | 0.29 | 1.02 | 0.21 | 1.01 | 0.55 | 1.01 | 0.81 | 1.02 | 0.04 |
| | L02 | 1000 | 1.00 | 0.99 | 1.02 | 0.27 | 1.01 | 0.79 | 1.02 | 0.68 | 1.00 | 0.81 |
| P | L0 | 50 | 0.98 | 0.39 | 1.00 | 0.75 | 1.01 | 0.61 | 1.00 | 0.88 | 0.98 | 0.15 |
| | L1 | 50 | 0.98 | 0.48 | 0.99 | 0.69 | 0.99 | 0.71 | 1.01 | 0.72 | 1.00 | 0.83 |
| | L2 | 50 | 1.02 | 0.38 | 1.01 | 0.38 | 1.01 | 0.67 | 1.00 | 0.87 | 1.01 | 0.11 |
| | L02 | 50 | 0.99 | 0.89 | 1.03 | 0.30 | 1.01 | 0.78 | 1.02 | 0.67 | 1.00 | 0.99 |
| "Biomass burning" | | | | | | | | | | | | |
| K | L0 | 50 | 0.98 | 0.06 | 1.00 | 0.64 | 1.01 | 0.01 | 1.01 | 0.02 | 1.00 | 0.68 |
| | L1 | 50 | 0.99 | 0.43 | 1.00 | 0.83 | 0.98 | 0.09 | 0.99 | 0.24 | 0.99 | 0.05 |
| | L2 | 50 | 1.00 | 0.85 | 1.00 | 0.46 | 1.00 | 0.38 | 0.98 | 0.07 | 1.00 | 0.59 |
| | L02 | 50 | 0.96 | 0.04 | 1.00 | 0.86 | 1.00 | 0.79 | 0.99 | 0.67 | 0.99 | 0.28 |
| "Oil" | | | | | | | | | | | | |
| V | L0 | 10 | 0.99 | 0.73 | 1.01 | 0.56 | 1.01 | 0.46 | 0.99 | 0.71 | 0.98 | 0.12 |
| | L1 | 10 | 0.96 | 0.03 | 0.99 | 0.24 | 0.98 | 0.24 | 0.98 | 0.32 | 1.00 | 0.68 |
| | L2 | 10 | 0.99 | 0.56 | 0.98 | 0.01 | 1.00 | 0.83 | 0.98 | 0.23 | 0.99 | 0.22 |
| | L02 | 10 | 0.93 | 0.04 | 0.96 | 0.05 | 0.98 | 0.58 | 0.94 | 0.12 | 0.96 | 0.03 |
| Ni | L0 | 5 | 1.01 | 0.59 | 1.01 | 0.21 | 1.04 | 0.05 | 1.01 | 0.58 | 1.01 | 0.48 |
| | L1 | 5 | 0.97 | 0.09 | 0.99 | 0.57 | 0.98 | 0.36 | 1.00 | 0.89 | 1.00 | 0.83 |
| | L2 | 5 | 1.00 | 0.76 | 0.99 | 0.23 | 1.00 | 0.81 | 0.98 | 0.27 | 0.99 | 0.51 |
| | L02 | 5 | 0.99 | 0.72 | 1.00 | 0.99 | 1.04 | 0.32 | 1.01 | 0.84 | 1.01 | 0.48 |

Table 2, cont.

| Source/ Element | Lag | ng/m ³ unit incr | Wheeze | | Persistent cough | | Shortness of breath | | Chest tightness | | Inhaler short-acting | |
|--------------------|-----|--------------------------------|--------|------|---------------------|------|------------------------|------|--------------------|------|-------------------------|------|
| | | | OR | p | OR | p | OR | p | OR | p | OR | p |
| "Sea salt" | | | | | | | | | | | | |
| Na | L0 | 100 | 0.98 | 0.23 | 1.00 | 0.58 | 1.00 | 0.94 | 0.99 | 0.43 | 0.99 | 0.35 |
| | L1 | 100 | 1.00 | 0.80 | 0.99 | 0.19 | 0.99 | 0.46 | 0.99 | 0.75 | 1.00 | 0.61 |
| | L2 | 100 | 1.00 | 0.88 | 1.00 | 0.61 | 1.01 | 0.63 | 1.00 | 0.88 | 1.00 | 0.85 |
| | L02 | 100 | 0.97 | 0.29 | 0.98 | 0.21 | 0.99 | 0.74 | 0.98 | 0.61 | 0.99 | 0.37 |
| Cl | L0 | 10 | 1.00 | 0.89 | 1.00 | 0.31 | 1.00 | 0.89 | 1.00 | 0.24 | 1.00 | 0.69 |
| | L1 | 10 | 1.00 | 0.88 | 1.00 | 0.31 | 1.00 | 0.94 | 1.00 | 0.28 | 1.00 | 0.52 |
| | L2 | 10 | 1.00 | 0.38 | 1.00 | 0.51 | 1.00 | 0.70 | 1.00 | 0.52 | 1.00 | 0.51 |
| | L02 | 10 | 1.00 | 0.81 | 1.00 | 0.06 | 1.00 | 0.80 | 1.00 | 0.65 | 1.00 | 0.83 |

^a Abbreviations: OR odds ratio, ng nanograms, PM_{2.5} particulate matter of 2.5 μm aerodynamic diameter or less.

Separate analyses were performed for each element and each respiratory symptom and medication use. Models were adjusted for season, day of week and date. ORs are given for the unit increase given in the second column for each element (and elemental carbon (EC)). Note that individual elements in fine particle mass may come from more than one source, but are listed here according to their major source. See Table 3 in the main paper for each source's contribution to each element's total mass.

Table 3. Odds ratios and p-values from separate repeated measures logistic regression analyses of associations between daily respiratory symptoms and medication use and each daily source concentration of PM_{2.5}. Each source is shown for exposures lagged by 0, 1 or 2 days (L0, L1, L2), and the mean of days 0 - 2 (L02). (N=149 asthmatic children)^a

| Source/ Lag | Wheeze | | Persistent cough | | Shortness of breath | | Chest tightness | | Inhaler short-acting | |
|--------------------------|--------|------|---------------------|------|------------------------|-------|--------------------|------|-------------------------|-------|
| | OR | p | OR | p | OR | p | OR | p | OR | p |
| "Motor vehicle" | | | | | | | | | | |
| L0 | 1.03 | 0.20 | 1.01 | 0.31 | 1.06 | 0.02 | 1.02 | 0.43 | 1.02 | 0.14 |
| L1 | 1.00 | 0.88 | 1.00 | 0.79 | 0.99 | 0.75 | 1.01 | 0.85 | 0.99 | 0.62 |
| L2 | 0.99 | 0.65 | 0.99 | 0.35 | 1.00 | 0.95 | 1.01 | 0.81 | 1.00 | 0.78 |
| L02 | 1.06 | 0.17 | 1.03 | 0.29 | 1.09 | 0.11 | 1.08 | 0.14 | 1.02 | 0.32 |
| "Road dust" | | | | | | | | | | |
| L0 | 1.10 | 0.02 | 1.06 | 0.01 | 1.12 | 0.006 | 1.05 | 0.32 | 1.06 | 0.003 |
| L1 | 1.02 | 0.65 | 1.01 | 0.75 | 1.04 | 0.38 | 1.07 | 0.13 | 0.97 | 0.20 |
| L2 | 1.04 | 0.36 | 1.01 | 0.62 | 1.00 | 0.95 | 1.00 | 0.92 | 1.01 | 0.61 |
| L02 | 1.23 | 0.02 | 1.16 | 0.02 | 1.25 | 0.01 | 1.20 | 0.07 | 1.08 | 0.06 |
| "Sulfur" | | | | | | | | | | |
| L0 | 0.98 | 0.18 | 1.00 | 0.74 | 0.99 | 0.60 | 0.99 | 0.56 | 0.98 | 0.02 |
| L1 | 0.99 | 0.54 | 0.99 | 0.56 | 0.99 | 0.70 | 1.01 | 0.72 | 1.00 | 0.54 |
| L2 | 1.02 | 0.19 | 1.02 | 0.11 | 1.01 | 0.36 | 1.01 | 0.63 | 1.01 | 0.03 |
| L02 | 0.99 | 0.68 | 1.01 | 0.45 | 0.99 | 0.82 | 1.01 | 0.86 | 1.00 | 0.92 |
| "Biomass burning" | | | | | | | | | | |
| L0 | 0.87 | 0.04 | 0.99 | 0.58 | 1.08 | 0.06 | 1.07 | 0.14 | 1.01 | 0.75 |
| L1 | 0.96 | 0.50 | 1.04 | 0.26 | 0.97 | 0.39 | 0.96 | 0.34 | 0.97 | 0.19 |
| L2 | 0.93 | 0.39 | 0.94 | 0.15 | 0.82 | 0.03 | 0.85 | 0.04 | 1.00 | 0.94 |
| L02 | 0.73 | 0.01 | 0.96 | 0.51 | 0.91 | 0.50 | 0.91 | 0.50 | 0.97 | 0.40 |

| | | | | | | | | | | |
|-------------------|------|------|------|------|------|------|------|------|------|------|
| "Oil" | | | | | | | | | | |
| L0 | 0.99 | 0.87 | 1.02 | 0.61 | 1.08 | 0.34 | 0.99 | 0.92 | 0.97 | 0.39 |
| L1 | 0.86 | 0.03 | 0.97 | 0.39 | 0.91 | 0.25 | 0.96 | 0.60 | 1.03 | 0.45 |
| L2 | 0.96 | 0.50 | 0.93 | 0.04 | 0.98 | 0.73 | 0.90 | 0.12 | 0.95 | 0.12 |
| L02 | 0.78 | 0.10 | 0.88 | 0.12 | 0.95 | 0.73 | 0.81 | 0.19 | 0.93 | 0.27 |
| "Sea salt" | | | | | | | | | | |
| L0 | 0.95 | 0.37 | 0.98 | 0.64 | 0.99 | 0.83 | 0.94 | 0.35 | 0.98 | 0.35 |
| L1 | 1.01 | 0.94 | 0.94 | 0.09 | 0.95 | 0.45 | 1.00 | 0.94 | 0.98 | 0.31 |
| L2 | 0.98 | 0.80 | 1.01 | 0.70 | 1.09 | 0.21 | 1.03 | 0.66 | 1.03 | 0.35 |
| L02 | 0.91 | 0.46 | 0.89 | 0.10 | 1.00 | 0.99 | 0.95 | 0.72 | 0.97 | 0.52 |
| PM _{2.5} | | | | | | | | | | |
| L0 | 1.00 | 0.86 | 1.00 | 0.82 | 1.03 | 0.24 | 1.02 | 0.41 | 1.00 | 0.66 |
| L1 | 0.98 | 0.32 | 1.00 | 0.96 | 0.99 | 0.62 | 1.02 | 0.42 | 1.00 | 0.90 |
| L2 | 1.03 | 0.26 | 1.01 | 0.67 | 1.01 | 0.70 | 1.01 | 0.61 | 1.01 | 0.52 |
| L02 | 1.00 | 0.96 | 1.00 | 0.90 | 1.04 | 0.42 | 1.09 | 0.07 | 1.00 | 0.92 |

Abbreviations: OR odds ratio, PM_{2.5} particulate matter of 2.5 μm aerodynamic diameter or less.

^a Separate analyses were performed for each source and each respiratory symptom and medication use. Models were adjusted for season, day of week and date. ORs are given for each 5 μg/m³ increase for each source or 10 μg/m³ increase in PM_{2.5}.